Translation of Jap. Pat. Appl. Kokai Publication No. H06-281943 (A)

Application No.	H05-092293
Filing Date	26 March 1993
Publication Date	7 October 1994
Int. Cl.^{5}	G02F 1/1343
Inventors	Yoshihiro HASHIMOTO, Toshio INAI and Takeshi HORIE
Applicant	Asahi Glass Company

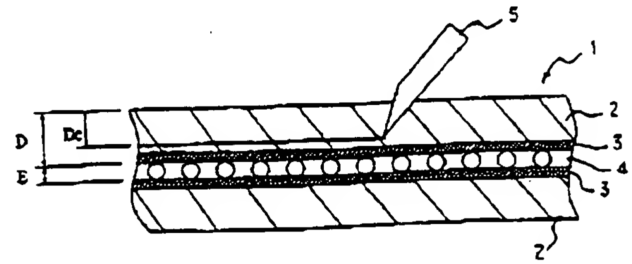
Title

Method of Forming an Electrode on a Liquid Crystal Film

Abstract

OBJECT: To simplify the process of forming an electrode.

CONSTITUTION: A cut is formed in upper insulating film 2 of liquid crystal film 1, and this insulating film is peeled off along the cut. As a result, it is peeled off — along with underlying liquid crystal layer 4 — from conductive film 3 on the lower insulating film.



ADVANTAGES: Productivity is increased, problematic air bubbles are eliminated, and a larger light control region is obtained.

Claims

1. In the context of a method of forming an electrode on a liquid crystal film wherein insulating films are provided, via intermediate conductive films, on the top and bottom surfaces of a liquid crystal layer:

a method of forming an electrode on a liquid crystal film comprising:

forming a cut in the upper insulating film along one margin [1]* of the liquid crystal film;

peeling off the insulating film along the cut on the side on which the electrode is to be formed;

thereby peeling off this upper insulating film, with the liquid crystal layer still adhering to its lower surface, from the conductive film on the lower insulating film.

2. The method of forming an electrode on a liquid crystal film set forth in claim 1, wherein the total thickness D of the conductive film and the insulating film [2] is 100 to 150 microns; the thickness E of the liquid crystal layer is 10 to 20 microns; and the value of D−Dc, where Dc is the depth of the cut, is 20 to 50 microns.

Detailed Description of the Invention

Industrial field of utilisation

(1) This invention relates to a method of forming an electrode on a liquid crystal film, and in particular to a method of forming an electrode on a liquid crystal film that is to be used in light control glass [3] wherein a liquid crystal film is provided, via intermediate films, between a pair of glass sheets.

* Numbers in square brackets refer to Translator's Notes appended to the translation.

Prior art

(2) The liquid crystal film that is used in liquid crystal based light control glass is constructed by laminating a polyester (PET) film onto the upper and lower surfaces of a liquid crystal layer, the PET film having first been coated with a conductive film of indium tin oxide (ITO). Electrodes for driving the liquid crystal are formed on the upper and lower ITO-coated insulating films (the PET films) of this liquid crystal film. The conventional method of forming electrodes on a liquid crystal film is as follows.

(3) Liquid crystal film of prescribed rectangular shape is cut out from a roll of liquid crystal film. The upper ITO-coated insulating film of this liquid crystal film is peeled off and folded back along the part where an electrode is to be formed, and an acrylic monomer — which is an insulating material for preventing short circuits — is injected between the two films along the folded-back part. After air has been removed following this injection, the upper folded-back ITO-coated insulating film is cut with a cutter and removed. Due to its elasticity, the cut margin of the remaining upper ITO-coated insulating film springs back and adheres to the acrylic monomer.

(4) Next, the cut part is covered with blasted Mylar [4] and the acrylic monomer is made uniformly thick by being rolled. The acrylic monomer is then cured by being irradiated using a UV lamp. After this, the blasted Mylar is peeled off. This results in any acrylic monomer resin protruding from the cut part being peeled off and removed from the lower ITO-coated insulating film along with the blasted Mylar. The surface of the conductive film (i.e., of the ITO film) on the lower ITO-coated insulating film is thereby exposed. Masking tape is affixed on this exposed conductive film, with an opening at the location where the electrode is to be formed. Silver paste is applied to the opening and after its thickness has been made uniform, the paste is dried, thereby forming an electrode.

Problems to be solved by the invention

(5) However, in the above-described conventional method of forming an electrode on a liquid crystal film, because resin is injected to prevent contact between the upper and lower ITO-coated insulating films in the region where the electrode is to be formed, several additional steps are required as well as resin injection, including film cutting, bubble removal and resin curing, with the result that the efficiency of the electrode formation operation is low and much time and effort is spent.

(6) Moreover, insufficient bubble removal has given rise to functional problems when applying the safety glass, due to residual air bubbles having migrated inwards. Another problem that has been encountered arises because the part where resin has been injected does not possess any light control capability. As a result, there is an increase in the size of the region in which light is not controlled, the full area of the light control film is not utilised effectively, and the resulting product is unavoidably larger and hence has less commercial viability.

(7) The present invention has been devised in the light of the aforementioned shortcomings of the prior art. It is an object of this invention to provide a method of forming an electrode on a light control film, which method offers the following benefits: processing is simplified without causing short circuits between the upper and lower ITO-coated insulating films; the electrode formation operation is performed

efficiently; productivity is increased; the problem of air bubbles is eradicated; and the light control region is increased.

Means for solving problems [5]

(8) In order to achieve the aforementioned object, the present invention — in the context of a method of forming an electrode on a liquid crystal film wherein insulating films are provided, via intermediate conductive films, on the top and bottom surfaces of a liquid crystal layer — comprises forming a cut in the upper insulating film along one margin of the liquid crystal film; peeling off the insulating film along the cut on the side on which the electrode is to be formed; thereby peeling off this upper insulating film, with the liquid crystal layer still adhering to its lower surface, from the conductive film on the lower insulating film.

(9) In a preferred embodiment, the total thickness D of the conductive film and the insulating film is 100 to 150 microns; the thickness E of the liquid crystal layer is 10 to 20 microns; and the value of D–Dc, where Dc is the depth of the cut, is 20 to 50 microns.

Working of the invention

(10) By forming a cut of suitable depth in the upper ITO-coated insulating film and peeling off the upper ITO-coated insulating film along this cut, the upper ITO-coated insulating film is peeled off and removed, along with the liquid crystal layer, from the lower ITO-coated insulating film, whereby the ITO film on the lower ITO-coated insulating film is exposed. An electrode is formed on this ITO film using silver paste or the like.

Embodiment

(11) FIG. 1 is a cross-sectional view of a liquid crystal film to which the method of forming an electrode according to this invention is to be applied. Liquid crystal film 1 comprises insulating film 2, of polyester or the like, laminated — with intermediate conductive films 3 of ITO or the like — onto the upper and lower surfaces of liquid crystal layer 4. By way of example, liquid crystal film 1 of this sort is formed by arranging two integrally-formed ITO-coated insulating films (made of PET) with their ITO coatings facing inwards towards each other and separated by spacers, and filling the interior space thus established with liquid crystal material.

(12) The ITO-coated insulating film used is one whose thickness D (i.e., the total thickness of insulating film 2 and conductive film 3) is 50 to 250 microns (μm) and preferably 100 to 150 μm. The thickness E of liquid crystal layer 4 is 5 to 30 μm and preferably 10 to 20 μm. A cut is formed, by means of cutter 5, in upper insulating film 2 of liquid crystal film 1 of this sort, along the part where an electrode is to be formed.

(13) Writing Dc for the depth of this cut, the value of D–Dc is 0 μm to 70 μm and preferably 20 μm to 50 μm. If the cut goes deeper and the value D–Dc becomes less than 20 μm, then during the cutting process the tip of cutter 5 may — due to variability in cutting precision — reach conductive film 3 that has been coated on insulating film 2 and may scratch or damage this. Such damage to upper conductive film 3 can lead to shorting between interior portions of the conductive film [6] and can cause sparking, etc.

ef h

(14) If the cut goes deeper still, the tip of cutter 5 may reach and damage conductive film 3 of the lower ITO-coated insulating film. Such damage to the lower conductive film — which is the surface on which the electrode will be formed — can lead to the resistance of the conductive film becoming abnormally high, or to poor connection to the electrode, with the result that the effective voltage is not applied to the liquid crystal. This leads to defective operation.

(15) Conversely, if the depth of the cut (Dc) is too shallow and the value of D-Dc becomes greater than 50 μm, then when the film is peeled off along the cut (in the manner to be described below), it may not peel off smoothly, the cut section may be ragged, which hinders subsequent processing steps, and peeling may occur also on the side of the cut on which the liquid crystal is intended to operate, which has an adverse effect on the operation of the liquid crystal. It is therefore desirable to ensure high-precision control of the depth of the cut into the ITO-coated insulating film by cutter 5, so that the value of D-Dc described above is between 20 μm and 50 μm.

(16) The inner side (i.e., the side on which the liquid crystal will operate) of the liquid crystal film on which a cut has been made in the manner described above is held down along the cut by a hold-down member as shown in FIG. 2 [7], and the outer margin side (i.e., the side on which the electrode is to be formed) is peeled off. When this is done, liquid crystal layer 4 is peeled off along with the ITO-coated insulating film (comprising insulating film 2 and conductive film 3). As a result, the conductive film of the lower ITO-coated insulating film is exposed. The electrode is formed by applying silver paste to this exposed ITO conductive film. The method of forming an electrode using this silver paste is the same as the conventional method.

(17) FIG. 3 shows the structure of light control glass employing a liquid crystal film that has been formed in this manner. Glass sheets 12 are attached, via intermediate films 11 of PVB, to both sides of liquid crystal film 1 on which electrode 10 has been formed.

(18) FIG. 4 shows the cross-sectional structure of liquid crystal film 1 on which the aforementioned electrode has been formed. Silver paste based electrodes 10 are formed in the manner described above on conductive films 3 on upper and lower insulating films 2. Grommet terminals 13 are fitted to these electrodes 10 and are connected to AC power source 14 by way of lead wires. Controlling the voltage applied by this AC power source controls the driving of the liquid crystal, whereby the amount of transmitted light is regulated.

(19) FIG. 5 shows an example of the configuration of a cutting jig for forming the aforementioned cut. Cutter 5 is attached to micrometer 7. Micrometer 7 is mounted on slide base 8 via holder 9. Numeral 15 references a spring for returning cutter 5. [8] The tip of cutter 5 is positioned with high precision by micrometer 7.

(20) The tip of this cutter 5 is made to project from the underside of slide base 8 by micrometer 7 so that the optimum depth of cut (as described above) is obtained, and the cut is formed by sliding slide base 8 along the surface of the liquid crystal film while applying a moderate load to the slide base.

(21) As an alternative to this configuration employing slide base 8, it is also feasible to employ a roller bearing that rolls over the surface of the liquid crystal film. In this

ef h

case, the cut is formed in the liquid crystal film by making the cutter project downwards from the bottom of the roller bearing and causing the roller to roll over the surface of the liquid crystal film. The amount by which the cutter projects can be minutely adjusted by the micrometer. It is also feasible to attach a fixed weight to the roller so that it travels under a constant load. Alternatively, the roller can be mounted on a guide rail or the like and can be made to travel by an electric motor. Such a configuration enables the cutting load and cutting velocity to be kept constant, so that the cutting operation is performed with a high degree of precision and a cut of constant depth is accurately formed.

(22) We now present the results obtained when cuts were actually formed on liquid crystal films by means of the slide base type cutting jig depicted in FIG. 5. A cutting line of depth 90 microns was inscribed in the 125 microns thick A surface [9] of a liquid crystal film by means of the cutter of the aforementioned cutting jig. When the film was peeled off along the cutting line, the layer of liquid crystal composition simultaneously peeled off, uncovering the conductive film surface of the B side film. We then inscribed a cutting line in the B side film on the opposite side to the aforementioned processing side [10], and likewise uncovered the conductive film surface on the A side. Electrodes were made by affixing copper tape to the respective conductive film surfaces and electrical operation made possible by connecting lead wires. Finally, safety glass was applied. The results of measurements of the electrical characteristics for n=10 [11] are given below. Problem-free light control glass was successfully manufactured.

(23) ITO resistance: 160 to 190 Ω/square
insulation resistance: 7 - 8 × 10^{-11} S/cm
high voltage test: no abnormalities

Advantages of the invention

(24) As has been described above, according to this invention an electrode is formed after exposing conductive film surface simply and reliably and without causing problems such as short circuits between the upper and lower conductive films. This is achieved by using a cutter to form a cut of appropriate depth and then peeling off film. Consequently, a conventional resin injection step is not necessary, the number of processing steps is decreased, manufacture is performed efficiently and in a short time, and manufacturing yield is improved. At the same time, expenditure on items such as resin material is cut, problems such as the formation of air bubbles accompanying resin injection do not arise, the entire surface of the liquid crystal layer can be effectively utilised as the operating region, and a more compact light control device can be realised.

Brief Description of the Drawings

FIG. 1 is a cross-sectional view showing how a cut is formed in a liquid crystal film by the electrode forming method of the invention.

FIG. 2 is a perspective view showing a liquid crystal film — in which a cut has been formed in accordance with this invention — being peeled off.

FIG. 3 shows the structure of light control glass employing a liquid crystal film in accordance with this invention.

FIG. 4 is a cross-sectional view after electrodes have been formed on a liquid crystal film in accordance with this invention.

FIG. 5 shows the configuration of a jig for cutting liquid crystal film in accordance with this invention.

Key to drawings

1 .... liquid crystal film
2 .... insulating film
3 .... conductive film
4 .... liquid crystal layer
5 .... cutter
6 .... hold-down member
7 .... micrometer
8 .... slide base
9 .... holder
10 .... electrode
11 .... intermediate film
12 .... glass sheet
13 .... grommet terminal
14 .... AC power source
15 .... spring

FIG. 1

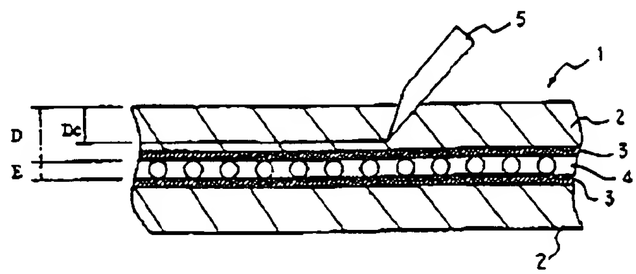


FIG. 2

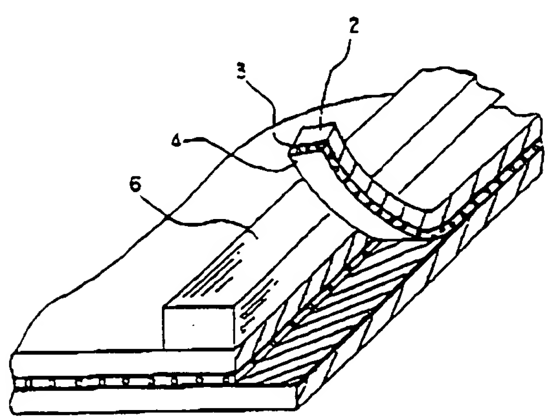


FIG. 3

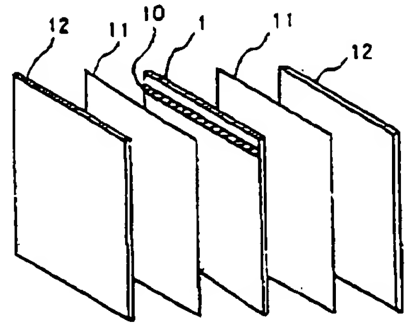


FIG. 4

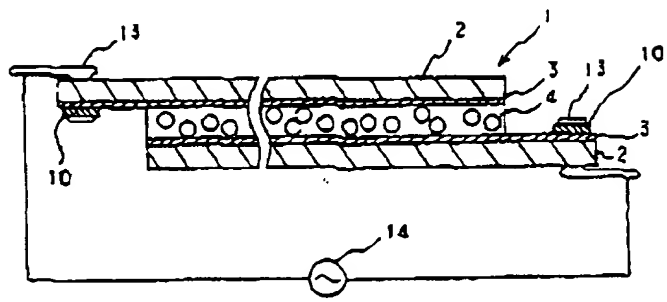
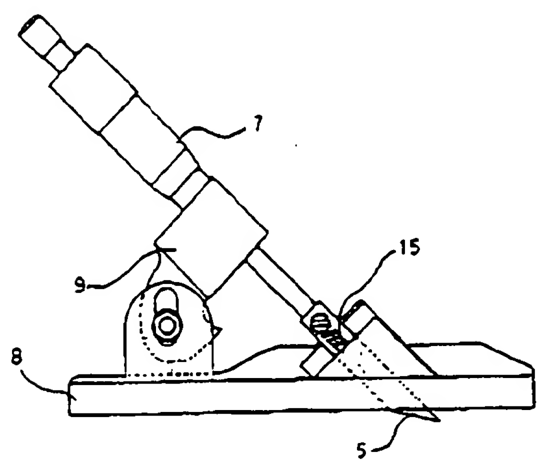


FIG. 5



TRANSLATOR'S NOTES

1. The Japanese word that I have translated as "margin" is used here with the implication of the vicinity of an edge or side, rather than the very edge or side.

2. The subsequent detailed description of the invention indicates that the writer is here meaning the combined thickness of either the top or bottom combination of insulating film and conductive film, *not* the total thickness of both pairs of films.

3. The Japanese term that I have translated as "light control glass" is typically used to signify large panels of safety glass between which is sandwiched liquid crystal sheet. However, it may also be taken as indicating any glass whose transmission/absorption/reflection characteristics can be controlled.

4. Sic. I do not know what type of Mylar this is.

5. Paragraphs 8 and 9 are exact re-statements of the claims.

6. Sic. The Japanese is ambiguous here. An alternative translation would be "shorting between the interiors of the conductive films". This latter would presumably mean shorting between the two conductive films opposing each other across the liquid crystal layer.

7. This specification does not mention that 6 in FIG. 2 references this hold-down member.

8. Sic. I am unsure what the writer means by this.

9. Neither the text nor the drawings gives any further explanation of this nomenclature. Possibly, "A" could stand for "above" and the subsequent "B" for "below".

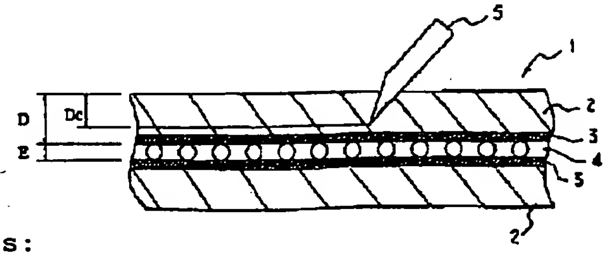
10. Sic. The writer is presumably referring to the opposite edge of the liquid crystal film - see FIG. 4.

11. Sic. The writer presumably means that measurements were made on 10 samples.

Patent Abstracts of Japan

PUBLICATION NUMBER : JP6281943
PUBLICATION DATE : 07-10-1994
APPLICATION NUMBER : JP19930092293
APPLICATION DATE : 26-03-1993

VOL: 1995 NO: 1
AB. DATE : 28-02-1995 PAT: A 6281943
PATENTEE : ASAHI GLASS CO LTD
PATENT DATE: 07-10-1994



INVENTOR : HASHIMOTO YOSHIHIRO; others: 02

INT.CL. : G02F1/1343

TITLE : FORMATION OF ELECTRODE OF LIQUID CRYSTAL FILM

ABSTRACT : PURPOSE:To expand a light control region, to simplify the process without shorting of the insulating films from each other, to efficiently execute an elec trode forming operation, to improving productivity and eliminating a trouble such as air bubbles as well by formig a cut on the insulatig film on a front surface side and pullig apart the insulating film on an electrode forming part side along this cut.

CONSTITUTION:The liquid crystal film is formed by laminating the insulating films 2 consisting of polyester, etc., via conductive films 3 consisting of ITO films, etc., on both front and rear surfaces of a liquid crystal layer 4. The cutting is formed by means of a cutter 5 on the insulating film 2 on the front surface side of the liquid crystal film 1 along the electrode forming parts. The liquid crystal film 1 having the cutting is retained on the inner side (liquid crystal operating part side) by a retaining member 6 along the cutting and the outer edge side (electrode forming part side) is pulled apart. The liquid crystal layer 4 is peeled as well together with the insulating film with the ITO film (the insulating film 2 and the conductive film 3). As a result, the conductive film of the insulating film with the ITO film on the lower side is exposed.

(19)日本国特許庁（ＪＰ）　(12) 公開特許公報（Ａ）　(11)特許出願公開番号

特開平6－281943

(43)公開日　平成6年(1994)10月7日

(51)Int.Cl.⁵	識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｇ０２Ｆ　1/1343		9017－2K		

審査請求　未請求　請求項の数２　ＦＤ　（全 ４ 頁）

(21)出願番号　特願平5－92293

(22)出願日　平成5年(1993)3月26日

(71)出願人　000000044
旭硝子株式会社
東京都千代田区丸の内２丁目１番２号

(72)発明者　橋本　吉弘
兵庫県尼崎市西向島町２番地　旭硝子株式会社関西工場内

(72)発明者　井内　敏夫
兵庫県尼崎市西向島町２番地　旭硝子株式会社関西工場内

(72)発明者　堀江　武
兵庫県尼崎市西向島町２番地　旭硝子株式会社関西工場内

(74)代理人　弁理士　泉名　謙治

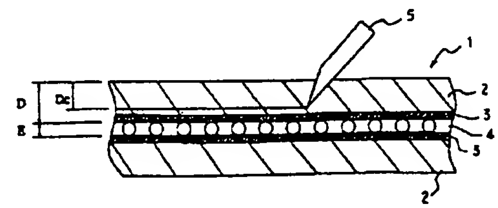
(54)【発明の名称】　液晶フィルムの電極形成方法

(57)【要約】

【目的】電極形成工程を簡素化する。

【構成】液晶フィルム１の上側の絶縁フィルム２に切込みを形成し、該切込みに沿って絶縁フィルム２を引き剥してその下面の液晶層４とともに下側の絶縁フィルム上の導電膜３から剥離させる。

【効果】生産性の向上、気泡問題の解消および調光領域の拡大が図られる。



BNS page 1

【特許請求の範囲】

【請求項1】液晶層の上下両面に導電膜を介して絶縁フィルムを設けた液晶フィルムの電極形成方法において、該液晶フィルムの一縁に沿って上面側の前記絶縁フィルムに切込みを形成し、該切込みに沿って電極形成部側の絶縁フィルムを引き剥すことにより、この上面側の絶縁フィルムをその下面に液晶層を固着させたまま、下面側の絶縁フィルム上の導電膜から剥離させることを特徴とする液晶フィルムの電極形成方法。

【請求項2】前記導電膜および絶縁フィルムの合計厚さDは100～150ミクロン、前記液晶層の厚さEは10～20ミクロンであり、前記切込みの深さをDcとしたとき、D－Dcを20～50ミクロンとしたことを特徴とする請求項1に記載の液晶フィルムの電極形成方法。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、液晶フィルムの電極形成方法に関し、特に一対のガラス板間に中間膜を介して液晶フィルムを設けた調光ガラスに用いられる液晶フィルムの電極形成方法に関するものである。

【0002】

【従来の技術】液晶による調光ガラスを構成する液晶フィルムは、液晶層の上下両面側にITO（インジウムすず酸化物）からなる導電膜をコーティングしたPET（ポリエステル）フィルムを積層して構成される。この液晶フィルムの上下両面のITO膜付絶縁フィルム（PETフィルム）には液晶駆動用の電極が形成される。従来の液晶フィルムの電極形成方法は以下のとおりである。

【0003】ロール状の液晶フィルムから所定の矩形形状の液晶フィルムが裁断される。この液晶フィルムの上面側のITO膜付き絶縁フィルムを剥して電極形成部に沿って折り返し、この折り返し部に沿って両フィルム間にショート防止用の絶縁材であるアクリルモノマーを注入する。注入後空気抜きをしてから上側の折り返したITO膜付き絶縁フィルムをカッターで切断除去する。残された上側のITO膜付き絶縁フィルムの切断縁部はその弾性によりアクリルモノマー上に戻されて付着する。

【0004】続いて、この切断部をブラストマイラーで覆いその上からロールでしごいてアクリルモノマーの厚みを均一にする。次に紫外線ランプによりアクリルモノマーを照射して硬化させる。その後、ブラストマイラーを引き剥す。これにより、切断部にはみ出していたアクリルモノマー樹脂がブラストマイラーとともに下側のITO膜付き絶縁フィルムから剥されて除去される。このようにして、下側のITO膜付き絶縁フィルムの導電膜（ITO膜）面が露出する。この露出した導電膜上に電極形成位置を開口させてマスキングテープを貼付し、開口部に銀ペーストを塗布し厚みを均一にした後乾燥させて電極を形成する。

【0005】

【発明が解決しようとする課題】しかしながら、前記従来の液晶フィルムの電極形成方法においては、電極形成部の上下両面のITO膜付き絶縁フィルム同士の接触防止のための樹脂注入工程を施しているため、工程数が多岐にまたがり、樹脂注入やフィルム切断、泡抜き、樹脂硬化等の多くの工程数を要し、電極形成作業の効率が悪く、多くの手間と時間を費やしていた。

【0006】また、泡抜きが不十分な場合、合わせガラス加工の際、残存気泡が内部側に移動して機能上の問題を生ずる場合があった。また樹脂注入部は調光機能をもたないため、非調光領域が大きくなり調光フィルム面積を有効に利用できず小型化が図られず商品性を低下させる等の問題があった。

【0007】本発明は上記従来技術の欠点に鑑みなされたものであって、上下両面のITO膜付き絶縁フィルム同士を短絡させることなく工程を簡素化し電極形成作業を効率的に行い生産性を向上させるとともに気泡等の問題をなくしかつ調光領域を拡大する調光フィルムの電極形成方法の提供を目的とする。

【0008】

【課題を解決するための手段】前記目的を達成するため、本発明においては、液晶層の上下両面に導電膜を介して絶縁フィルムを設けた液晶フィルムの電極形成方法において、該液晶フィルムの一縁に沿って上面側の前記絶縁フィルムに切込みを形成し、該切込みに沿って電極形成部側の絶縁フィルムを引き剥すことにより、この上面側の絶縁フィルムをその下面に液晶層を固着させたまま、下面側の絶縁フィルム上の導電膜から剥離させる。

【0009】好ましい実施例においては、前記導電膜および絶縁フィルムの合計厚さDは100～150ミクロン、前記液晶層の厚さEは10～20ミクロンであり、前記切込みの深さをDcとしたとき、D－Dcを20～50ミクロンとしている。

【0010】

【作用】上面側のITO膜付き絶縁フィルムに適当な深さの切込みを形成し、この切込みに沿って上面側のITO膜付き絶縁フィルムを引き剥すことにより、液晶層とともに上側のITO膜付き絶縁フィルムが下側のITO膜付き絶縁フィルムから剥離除去され、下側のITO膜付き絶縁フィルム上のITO膜が露出する。このITO膜上に銀ペースト等を用いて電極が形成される。

【0011】

【実施例】図1は本発明に係る電極形成方法が適用される液晶フィルムの断面図である。液晶フィルム1は、液晶層4の上下両面にITO膜等からなる導電膜3を介してポリエステル等からなる絶縁フィルム2を積層したものである。このような液晶フィルム1は、例えば2枚の一体形成されたITO膜付き絶縁フィルム（PET）を

ＩＴＯ膜側を内面にしてスペーサを介して対向配置し内部に液晶材料を充填して形成される。

【0012】このＩＴＯ膜付き絶縁フィルムはその厚み（絶縁フィルム２と導電膜３の合計の厚み）Ｄが５０～２５０ミクロン（μm）、好ましくは１００～１５０μmのものが用いられる。また、液晶層４の厚みＥは５～３０μm、好ましくは１０～２０μmである。このような液晶フィルム１の電極形成部に沿って、その上面側の絶縁フィルム２にカッター５により切込みが形成される。

【0013】この切込みの深さをＤｃとすると、Ｄ－Ｄｃの値は０μm～７０μm、好ましくは２０μm～５０μmである。切込みが深くなって、このＤ－Ｄｃの値が２０μm以下になると、切断精度のばらつきによりカッター５の刃先が切断中の絶縁フィルム２にコーティングされた導電膜３に達しこれを傷つける場合がある。このように上面の導電膜３が傷つくと導電膜内部同士でショートし火花等を発する原因になる。

【0014】さらに切込みが深くなれば、カッター５の刃先が下側のＩＴＯ膜付き絶縁フィルムの導電膜３に達してこれを傷つける場合がある。このように電極形成面である下側の導電膜に傷がつくと導電膜の抵抗が異常に大きくなりあるいは電極との接続不良となり液晶に対し実効電圧が印加されず動作不良の原因となる。

【0015】逆に、切込みの深さＤｃが浅過ぎて、Ｄ－Ｄｃの値が５０μm以上になると、後述のように切込みに沿ってフィルムを引き剥すときに、円滑にフィルムが剥離しないばかりでなく、切り口が不揃いとなって後の処理工程に支障を来したり、液晶動作部側にも剥離が生じて液晶動作に悪影響を与える場合がある。従って、カッター５によるＩＴＯ膜付き絶縁フィルムの切込み深さを高精度に調節して前述のＤ－Ｄｃの値が２０μmから５０μmの間になるように切断することが望ましい。

【0016】このようにして切込みが形成された液晶フィルムは、図２に示すように、切込みに沿って押え部材６により内側（液晶動作部側）を押えられ、外縁部側（電極形成部側）が引き剥される。このときＩＴＯ膜付き絶縁フィルム（絶縁フィルム２および導電膜３）とともに液晶層４も剥離される。これにより、下側のＩＴＯ膜付き絶縁フィルムの導電膜が露出する。この露出したＩＴＯ導電膜上に銀ペーストを塗布して電極が形成される。この銀ペーストによる電極形成方法は従来と同じである。

【0017】図３は、このようにして形成された液晶フィルムを用いた調光ガラスの構成を示す。電極１０が形成された液晶フィルム１の両面にＰＶＢからなる中間膜１１を介してガラス板１２が装着される。

【0018】図４は、上記電極が形成された液晶フィルム１の断面構成を示す。上下両側の絶縁フィルム２上の導電膜３に、前述のようにして、銀ペーストによる電極１０が形成される。この電極１０にハトメ端子１３が取り付けられ、リード線を介して交流電源１４に接続される。この交流電源による印加電圧を制御することにより、液晶を駆動制御して透過光量が調整される。

【0019】図５は、上記切込みを形成するための切断治具の一例の構成を示す。カッター５はマイクロメーター７に装着される。マイクロメーター７はホルダー９を介してスライドベース８上に取り付けられる。１５はカッター５を戻すためのスプリングである。カッター５の刃先位置はマイクロメーター７により高精度に位置決めされる。

【0020】このカッター５の刃先を、前述のように最適な切込み深さとなるようにマイクロメーター７によりスライドベース８の底面より突出させ、スライドベース８に適度な荷重をかけながら液晶フィルム面に沿って摺動させることにより前述の切込みが形成される。

【0021】このようなスライドベース８を用いた構成に代えて、液晶フィルム面上を転動するローラーベアリングを用いてもよい。この場合、カッターはローラーベアリングの底部より下側に突出させてローラーを液晶フィルム面上で転動させこの液晶フィルムに切込みを形成する。カッターの突出量はマイクロメーターにより微調整可能である。また定量ウェイトを装着して一定荷重でローラーを走行させてもよい。またローラーをガイドレール等に取り付けて、電動走行させてもよい。このような構成により、切断荷重および切断速度を一定に保つことができ、切断動作が高精度で行われ一定の深さの切込みが精度よく形成される。

【0022】以下、図５に示したスライドベースを用いた切断治具により実際に液晶フィルムに切込みを形成した結果を示す。上記切断治具のカッターにより、液晶フィルムのＡ面側の厚み１２５ミクロンに対し深度９０ミクロンの切込み線をつけた。切込み線に沿ってフィルムを剥したところ、液晶組成物の層も同時に剥れ、Ｂ面側のフィルムの導電膜面を取り出した。次に上記加工側とは対辺のＢ面側のフィルムに切込み線をつけ同様にＡ面側の導電膜面を取り出した。それぞれの導電膜面に銅テープを貼り付けて電極とし、リード線を接続して電気作動を可能とし、合わせガラス化しｎ＝１０の電気的特性を測定した結果は下記のとおりであり、問題のない調光ガラスを作成できた。

【0023】ＩＴＯ抵抗：１６０～１９０Ω／□
絶縁抵抗：７～８×１０－１１Ｓ／ｃｍ
高電圧テスト：異常なし

【0024】

【発明の効果】以上説明したように、本発明においては、カッターにより適当な深さの切込みを形成してフィルムを引き剥すことにより、上下両導電膜間の短絡等の問題を生ずることなく、簡単に確実に導電膜面を露出させて電極を形成することができる。従って、従来のよう

な樹脂注入工程が不要になり、工程数が減少して作業が効率的に短時間で行われ歩留の向上が図られるとともに樹脂材料等の経費が削減され、さらに樹脂注入に伴う気泡発生等の問題が起こらず、また液晶層の全面を有効に動作領域として利用することが可能になりコンパクトな調光装置を実現できる。

【図面の簡単な説明】

【図1】本発明に係る電極形成方法により液晶フィルムに切込みを形成する方法を示す断面図

【図2】本発明により切込みを形成した液晶フィルムを引き剥す状態を示す斜視図

【図3】本発明に係る液晶フィルムを用いた調光ガラスの構成図

【図4】本発明に係る液晶フィルムの電極形成後の断面図

【図5】本発明に係る液晶フィルム切断用治具の構成図

【符号の説明】

1：液晶フィルム

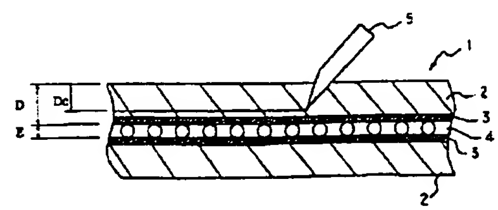
2：絶縁フィルム

3：導電膜

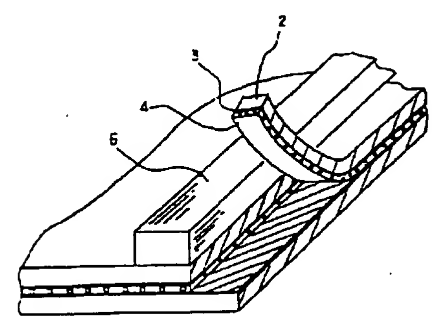
4：液晶層

5：カッター

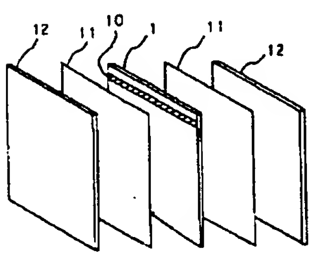
【図1】



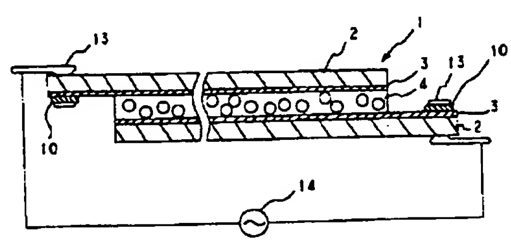
【図2】



【図3】



【図4】



【図5】